CHAPTER

8

TROUBLESHOOTING FUNDAMENTALS

In this chapter, you will learn:

- How to protect yourself, your hardware, and your software while solving computer problems
- What tools are needed to support personal computers
- How to isolate computer problems and devise a course of action
- The importance of good recordkeeping
- How to take a computer apart and put it back together

This chapter addresses some common-sense guidelines to solving computer problems. Before describing specific hardware or software problems, the chapter outlines some safety precautions to always follow as you work. In trying to solve a computer problem, you want to avoid making the situation worse by damaging hardware, software, valuable data, or yourself. The chapter goes on to discuss essential troubleshooting tools and others that are "nice to have." You will then learn strategies for solving computer problems, how to isolate each potential source of a problem, and general guidelines for dealing with problems. Next, the chapter methodically explains how to isolate the source of several problems and then resolve them.

The last part of the chapter covers defensive procedures that make computer problems easier to handle, such as backing up hardware and software, write-protecting application disks, and keeping records and documentation. These procedures minimize user losses if hardware or software fails, and reduce the time needed to get a system running again. In the end-of-chapter projects, you can hone your troubleshooting skills by disassembling and reassembling a PC.

Remember that every time you work on your PC, you risk hurting yourself, the hardware, and the software. Before attempting repairs, follow the important safety precautions at the end of Chapter 3 and in the "Read This Before You Begin" section following the introduction of this book. Remember that you can compound a problem, and cause more damage, by neglecting these precautions.

TROUBLESHOOTING PERSPECTIVES

As a PC troubleshooter, you might have to solve a problem on your own PC or for someone else. As a PC technician, you might fulfill four different job functions:

- A PC support technician working on-site who closely interacts with users and is responsible for ongoing PC maintenance
- A PC service technician who goes to a customer site in response to a service call and, if possible, repairs a PC on-site
- A bench technician working in a lab environment, who perhaps does not interact with users of the PCs being repaired, and is not permanently responsible for them
- A help-desk technician providing telephone support

A PC support technician is the only one listed above who is responsible for the PC before trouble occurs, and therefore can prepare for a problem by keeping good records and maintaining backups (or teaching the user how to do so).

PC service technicians are usually not responsible for ongoing PC maintenance, but usually can interact with the user.

Bench technicians probably don't work at the same site where the PC is kept. They may be able to interview the user to get information about the problem, or may simply receive a PC to repair without being able to talk to the user.

Help-desk technicians, who do not have physical access to the PC, are at the greatest disadvantage of the four. They can only interact with users over the phone and must obviously use different tools and approaches than the technician at the PC.

This chapter emphasizes the job of the on-site PC support technician. However, the special needs and perspectives of the service technician, bench technician, and help-desk technician are also addressed.

TROUBLESHOOTING TOOLS

Before we turn our attention to how to troubleshoot a PC problem, we will first look at the hardware and software tools needed to help you diagnose and repair computer problems. The tools you choose depend on the amount of money you can spend and the level of PC support you are providing.

Tools that are essential for PC troubleshooting are listed below. All but the bootable rescue disk can easily be purchased in one handy PC tool kit:

- Bootable rescue disk
- Ground bracelet and/or ground mat
- Flat-head screwdriver

- Phillips-head or cross-head screwdriver
- Torx screwdriver
- Tweezers for picking pieces of paper out of printers or dropped screws from tight places
- Chip extractor to remove chips (to pry up the chip; a simple screwdriver is usually more effective, however)
- Extractor, a spring-loaded device that looks like a hypodermic needle (when you push down on the top, three wire prongs come out that can be used to pick up a fallen screw, where hands and fingers can't reach)

The following tools might not be essential, but they are very convenient:

- Multimeter to check the power supply output (this is discussed in Chapter 11)
- Needle-nose pliers for holding objects in place while you screw (especially those pesky nuts on cable connectors)
- Flashlight to see inside the PC case
- AC outlet ground tester
- Small cups or bags to help keep screws organized as you work
- Antistatic bags to store unused parts
- Pen and paper for taking notes
- Diagnostic cards and diagnostic software
- Utility software
- Virus detection software on disks

Keep your tools in a tool box designated for PC troubleshooting. If you put disks and hardware tools in the same box, don't include a magnetized screwdriver, and be sure to keep the disks inside a plastic case. Make sure the diagnostic and utility software you use is recommended for the hardware and software you are troubleshooting.

Four tools from the list above are discussed here in more detail: bootable rescue disks, diagnostic cards and diagnostic software, utility software, and virus detection software.

Bootable Rescue Disk

An essential tool for PC troubleshooting is a **bootable rescue disk**. Not only can it boot the PC even when the hard drive fails, but you are assured the cleanest boot possible. By "clean boot," we mean that the boot does not load any extraneous software, drivers, or other memory-resident programs (TSRs), which might be loaded from startup routines on the hard drive.

A+CORE 2.2

Bootable Disk for DOS

For DOS, make a bootable disk using the same version of DOS that is on the PC's hard drive. Use this command:

```
C:\> FORMAT A:/S
```

The /S option tells DOS to copy to the disk the files needed to load DOS from it. This command also puts the two DOS hidden files and COMMAND.COM on the disk. The disk will include a small boot record that identifies the disk layout and the names of the two hidden files.

It's important that the boot disk have the same version of DOS that is on the hard drive. If you're consistent with versions, then once you're booted you can use some of the DOS loaded from the disk and some DOS program files on the hard drive, without DOS displaying error messages about using different versions. Use the VER command at the DOS prompt to display the current version of DOS.

You can also add some DOS utility commands to the disk so it can serve as a rescue disk if needed. In addition to the boot files, copy these files to the disk:

- ATTRIB.EXE
- CHKDSK.EXE
- EDIT.COM (which may also require QBASIC.EXE if you are using an older version of DOS)
- EMM386.EXE
- FDISK.EXE
- FORMAT.COM
- MSCDEX.EXE
- SCANDISK.EXE
- SYS.COM
- DEFRAG.EXE
- HIMEM.SYS
- UNDELETE.EXE

Rescue Disk for Windows 9x

For Windows 9x, make a rescue disk, as discussed in Chapter 2. To make a rescue disk for Windows 95, also include the files needed to access the CD-ROM without depending on the hard drive (see Chapter 9). Windows 98 places these real-mode driver files on the disk automatically.

Diagnostic Cards and Software

Although not essential, many hardware and software tools can help you diagnose a PC problem. Before purchasing these tools, read the documentation about what they can and cannot do, and, if possible, read some reviews about the product. The Internet is a good source of information. One hardware diagnostic tool is a diagnostic card, which is discussed next. Then we will look at several diagnostic software applications.

POST Diagnostic Cards

Diagnostic cards are designed to discover and report computer errors and conflicts at POST. If you have a problem that prevents the PC from booting, you can install the diagnostic card in an expansion slot on the system board and then attempt to boot. The card monitors the boot process and reports errors, usually as coded numbers on a small LED panel on the card. You then look up the number in the documentation that accompanies the card to get more information about the error and its source.

Examples of these cards are:

- POSTcard V3 by Unicore Software, Inc. (*www.unicore.com*)
- Post Code Master by MSD, Inc. (*www.msd.com*)
- POSTmortem Diagnostics Card by System Optimization, Inc. (*www.sysopt.com*)

Diagnostic Software

Diagnostic software is generally used to identify hardware problems. Although many diagnostic software programs are available, here we look at only a few. If the software rates itself as being at the professional level, it generally assumes greater technical expertise and also provides more features than end-user or novice-level software. The most effective diagnostic software does not run from the OS, because the OS may sometimes mask a hardware problem. Here are a few examples of diagnostic software.

PC-Technician by Windsor Technologies, Inc.

This professional-level PC diagnostic software loads and operates without using the PC's installed operating system, because it has its own proprietary OS built in. Results are thus unaltered by any errors in the PC's OS.

PC-Technician can relocate itself during testing and successfully test all of main memory. The ability to relocate is important, since software that tests memory cannot test the portion where it is currently loaded.

PC-Technician bypasses standard ROM BIOS when translation mode is used by the system, so that the diagnostic software communicates directly with the hard drive controller. Recall from Chapter 6 that translation mode is a method used by ROM BIOS to communicate with the controller BIOS of large hard drives. Any errors that might be masked by ROM BIOS translation methods are uncovered if the diagnostic software can communicate directly with the hard drive BIOS.

PC-Technician performs over 200 tests, including main memory, extended memory, expanded memory, hard drives, disk drives, video display, video cards, serial and parallel ports, and keyboards.

PC-Technician comes with test plugs (called loop-back plugs) that test parallel and serial ports by looping data out of and back to the port. These loop-back tests (also called wrap tests) determine that hardware ports are working.

There is a downloadable version of this software called TuffTEST-Pro. For more information, see the company Web site at *www.windsortech.com*.

PC-Diagnosys by Windsor Technologies, Inc.

This software is designed for less experienced PC technicians and end users. It contains a small subset of the features of PC-Technician discussed above, thus reducing the cost of the product. It's easy to use and includes its own proprietary OS so that the PC's OS will not mask results of the diagnostic tests.

Tests include main memory, extended memory, hard drives, disk drives, video display, video cards, and serial and parallel ports. See *www.windsortech.com*.

General Purpose Utility Software for Updates and Fixes

Utility software can be designed to diagnose problems, repair and maintain the software on a PC, recover corrupted or deleted data on the hard drive or floppy disks, provide security, monitor system performance, and download software updates from the Internet. The utility software might use the installed operating system or might provide its own. Examples of utility software include the following:

First Aid 2000 by McAfee

First Aid 2000 surveys and repairs problems with Windows 95 and Windows 98, including nonworking Windows 95 Shortcuts. It can connect to the Internet to update older versions of device drivers and Windows system files. It does not update applications software.

First Aid was originally written by Cybermedia, which is now a part of the McAfee Software Division of Network Associates. For more information on the product, see the McAfee Web site at *www.mcafee.com*.

McAfee Utilities Deluxe

McAfee Utilities Deluxe is a suite of utilities that includes protection from viruses using VirusScan, system performance monitoring, data backup, recovery from a corrupted file system or corrupted data, and software updates from the Internet. For more information, see *www.mcafee.com*.

Nuts & Bolts by Network Associates

Nuts & Bolts by McAfee Software of Network Associates is a comprehensive package including data recovery, security, system monitoring, and hard drive cleanup utilities. Nuts & Bolts was introduced in earlier chapters. The retail version of Nuts & Bolts is sold within the McAfee Office 2000 software suite. The company web site is *www.mcafee.com*.

Norton Utilities by Symantec

Norton Utilities by Symantec is general-purpose, user-friendly utility software that provides a variety of functions, including the ability to recover lost or damaged data from a hard drive. It is discussed in some detail in Chapter 7. The company web site is *www.symantec.com*.

CheckIt 98 Diagnostic Suite by Touchstone Software

CheckIt by Touchstone is a general-purpose software and hardware utility product that includes hard drive testing, performance testing, port testing (loop-back plugs are included), and setup, for resource conflicts. The product web site is *www.checkit.com*.

PartitionMagic by PowerQuest

PartitionMagic, first discussed in Chapter 7, lets you create, resize, and merge partitions on a hard drive without losing data. You can use the software to easily run multiple operating systems, convert file system types, and fix partition table errors. The product web site is *www.powerquest.com/partitionmagic*.

EasyRestore by PowerQuest

EasyRestore is a system recovery utility that allows any user to quickly and easily recover from a hard drive failure, if EasyRestore had been used earlier to back up the hard drive to CD when the drive was healthy. The product web site is *www.powerquest.com/easyrestore*.

Drive Image, Drive Image Pro, and DriveCopy by PowerQuest

Drive Image and Drive Image Pro both offer quick recovery from a failed hard drive if the drive has been backed up previously. These two applications, and the less powerful DriveCopy software, provide a way to easily copy software on one hard drive to another without having to install each software application on the new drive. This process, called cloning the hard drive, can be useful in a corporate or educational environment where many PCs contain exactly the same software loads. The manufacturer web site is *www.powerquest.com*.

Norton Ghost by Symantec

Norton Ghost by Symantec will also clone a hard drive, resize hard drive partitions without destroying data, create compressed hard drive backups, and restore a hard drive from a healthy image created earlier. The company web site is *www.symantec.com*.

Virus Detection Software

A+ OS 3.2

When you are troubleshooting PCs that show symptoms of either hardware or software problems, a virus is sometimes the cause, so virus detection software is an important tool to have. This section lists and describes some virus detection software and gives you background information about viruses in general.

A computer virus is a program that is transmitted to a computer, without the user's knowledge, with the intention of doing harm. Viruses can attach themselves to any executable program, but cannot become active until the host program is active. The programming code of the virus stays in memory or on disk as part of the host program until it executes. Then the virus either does its damage (called dropping its payload) or replicates itself into another program, either on the same medium or a different one. A virus can hide in an executable file such as COMMAND.COM or in any other program. A common place for a virus to hide is in a macro within a word-processing document or spreadsheet. They also can hide in the DOS boot record on a hard drive or floppy disk, or in the partition table load program on the hard drive. They can lie dormant for an extended time and, once active, can do mild or deadly damage. Viruses are usually transmitted by disks that contain program code, by program files downloaded from the Internet, or by documents with macros sent as e-mail attachments.

If you suspect that a virus may be involved in a computer problem, use a virus scan program to scan memory and the hard drive. Virus detection software, sometimes called antivirus software, searches hard drives and disks, informs you of the presence of a virus, and asks permission before deleting it. Some warning signs that a virus is present are:

- A program takes longer than normal to load.
- Disk access times seem excessive for simple tasks.
- Executable files that once worked no longer work and give unexpected error messages.
- Unusual error messages occur regularly.
- Less memory than usual is available.
- Files disappear mysteriously.
- There is a noticeable reduction in disk space.
- Executable files have changed size.
- The access lights on hard drives and floppy drives turn on when there should be no activity on those devices.
- You can't access a drive. This can be a hard drive, CD-ROM drive, Zip drive, or floppy drive.
- The system won't boot.
- Print services are not working properly.

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An antivirus program is no better than the kinds of viruses it knows how to detect and erase. When choosing such software, check whether periodic updates are available from the company web site or another online service, so you can update the software for protection against new and different viruses as they arise. Some antivirus software programs on the market include the following:

- F-Protect (PROT) is rated as a high-quality antivirus product with excellent scanning and removal ability. The company web site is *www.complex.is*.
- McAfee VirusScan (SCAN) is probably the best-known antivirus software product. The company web site is *www.mcafee.com*.
- Norton AntiVirus (NAV) is popular because of its ease of use and graphical interface. The company web site is *www.symantec.com*.

Reducing the Threat of a Virus

Some things that you can do to reduce the threat of viruses are:

- Write-protect original software disks and backup copies.
- Boot from your hard disk or a write-protected disk only.
- Avoid downloading from the Internet or a bulletin board, or always use a virus scan program when you do.
- Use a scan utility such as Norton Anti-Virus or McAfee's SCAN on a regular or even daily basis.

Don't be a carrier yourself. When working on a PC, be careful not to transmit a virus from your own bootable disk. Make a practice of scanning your bootable rescue disk for viruses before using it to troubleshoot another PC.

8

How to Isolate Computer Problems and Devise a Course of Action

When a computer doesn't work and you're responsible for fixing it, you should generally approach the problem first as an investigator and discoverer, always being careful not to compound the problem through your own actions. If the problem seems difficult, see it as an opportunity to learn something new. Ask questions until you understand the source of the problem. Once you understand it, you're almost done, because most likely the solution will be evident. Take the attitude that you can understand the problem and solve it, no matter how deeply you have to dig, and you probably will. In this section we look at how to approach a troubleshooting problem, including how to interact with the user and how to handle an emergency.

Fundamental Rules

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Here are a few fundamental rules for PC troubleshooting that I've found work for me.

- **Approach the problem systematically.** Start at the beginning and walk through the situation in a thorough, careful way. This one rule is worth its weight in gold. Remember it and apply it every time. If you don't find the explanation to the problem after one systematic walk-through, then repeat the entire process. Check and double-check to find the step you overlooked the first time. Most problems with computers are simple, such as a loose cable or circuit board. Computers are logical through and through. Whatever the problem, it's also very logical.
- **Divide and conquer.** This rule is the most powerful. Isolate the problem. In the overall system, remove one hardware or software component after another, until the problem is isolated to a small part of the whole system. You will learn many methods of applying this rule in this book. For starters, here are a few:
  - Remove any memory-resident programs (TSRs) to eliminate them as the problem.
  - Boot from a disk to eliminate the OS and startup files on the hard drive as the problem.
  - Remove any unnecessary hardware devices, such as a scanner card, internal modem, and even the hard drive.

  Once down to the essentials, start exchanging components you know are good for those you suspect are bad, until the problem goes away.
- **Don't overlook the obvious.** Ask simple questions. Is the computer plugged in? Is it turned on? Is the monitor plugged in? Most problems are so simple that we overlook them because we expect the problem to be difficult. Don't let the complexity of computers fool you. Most problems are simple and easy to fix. Really, they are!
- **Check the simple things first.** It is more effective to first check the components that are easiest to replace. For example, if the video does not work, the problem may be with the monitor or the video card. When faced with the decision of which one to exchange first, choose the easy route: exchange the monitor before the video card.
- **Make no assumptions.** This rule is the hardest one to follow, because there is a tendency to trust anything in writing and assume that people are telling you exactly what happened. But documentation is sometimes wrong, and people don't always describe events as they occurred—so do your own investigating. For example, if the user tells you that the system boots up with no error messages, but that the software still doesn't work, boot for yourself. You never know what the user might have overlooked.

A+CORE 2.2

- **Become a researcher.** Following this rule is the most fun. When a computer problem arises that you can't easily solve, be as tenacious as a bulldog. Read, make phone calls, ask questions, then read, make more calls, and ask more questions. Take advantage of every available resource, including online help, the Internet, documentation, technical support, and books such as this one. What you learn will be yours to take to the next problem. This is the real joy of computer troubleshooting. If you're good at it, you're always learning something new.
- **Write things down.** Keep good notes as you're working. They'll help you think more clearly. Draw diagrams. Make lists. Write down clearly and precisely what you're learning. Later, when the entire problem gets "cold," these notes will be invaluable.
- **Reboot and start over.** This is an important rule. Fresh starts are good for us and uncover events or steps that might have been overlooked. Take a break; get away from the problem. Begin again.
- **Establish your priorities.** This rule can help make for a satisfied customer. Decide what your first priority is. For example, it might be to recover lost data, or to get the PC back up and running as soon as possible. Consult the user or customer for advice when practical.
- **Keep your cool.** In an emergency, protect the data and software by carefully considering your options before acting, by not assuming data is lost even when hard drive and floppy drive errors occur, and by taking practical precautions to protect software and OS files. When a computer stops working, if unsaved data is still in memory or if data or software on the hard drive has not been backed up, look and think carefully before you leap! A wrong move can be costly. The best advice is: don't hurry. Carefully plan your moves. Read the documentation if you're not sure what to do, and don't hesitate to ask for help. Don't simply try something, hoping it will work—unless you've run out of more intelligent alternatives!
- **Don't assume the worst.** When it's an emergency and your only copy of data is on a hard drive that is not working, don't assume that the data is lost. Much can be done to recover data, as you learned in Chapter 7, but one important point is worth repeating. If you want to recover lost data on a hard drive, don't write anything to the drive; you might write on top of lost data, eliminating all chances of recovery.
- **Know your starting point.** Before trying to solve a computer problem, know for certain that the problem is what the user says it is. If the computer does not boot, carefully note where in the boot process it fails. If the computer does boot to an OS, before changing anything or taking anything apart, verify what does and what doesn't work, preferably in the presence of the user.

Devising a Course of Action

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When solving a computer problem, the above rules prepare you to apply a successful course of action. This course of action is threefold:

1. Interact with the user. Gather as much information up front as you can before you start problem-solving. Have the user describe the problem in detail, and ask questions. Don't settle for secondhand information unless you have no choice. Later, as you work, consult the user before taking drastic action, such as formatting the hard drive.
2. Isolate the problem by (a) eliminating the unnecessary and (b) trading good for suspected bad.
3. Then follow established guidelines toward a solution. Many of these are listed later in the chapter, and you'll find many more in other chapters.

Interacting with the User

Ask the user to explain exactly what happened when the computer stopped working. What procedure was taking place at the time? What had just happened? What recent changes did the user make? When did the computer last work? What has happened in the meantime? What error messages did the user see? Re-create the circumstances that existed when the computer stopped, and in as much detail as you can. Make no assumptions. All users make simple mistakes and then overlook them. If you realize that the problem was caused by the user's mistake, take the time to explain the proper procedures, so that the user understands what went wrong and what to do next time.

Use diplomacy and good manners when you work with a user to solve a problem. For example, if you suspect that the user dropped the PC, don't ask "Did you drop the PC?" but rather put the question in a less accusatory manner: "Could the PC have been dropped?" If the user is sitting in front of the PC, don't assume you can take over the keyboard or mouse without permission. Also, if the user is present, ask permission before you make a software or hardware change, even if the user has just given you permission to interact with the PC.

When working at the user's desk, consider yourself a "guest" and follow these general guidelines:

- Don't "talk down" to or patronize the user.
- Don't take over the mouse or keyboard from the user without permission.
- Don't use the phone without permission.
- Don't pile your belongings and tools on top of the user's papers, books, etc.
- Accept personal inconvenience to accommodate the user's urgent business needs. For example, if the user gets an important call while you are working, delay your work until the call is over.

A+CORE 2.2

Whether or not you are at the user's desk, you should follow these guidelines when working with the user:

- Don't take drastic action such as formatting the hard drive before you ask the user about important data that may not be backed up.
- Provide users with alternatives where appropriate before making decisions for them.
- Protect the confidentiality of data on the PC such as business financial information.
- Don't disparage the user's choice of computer hardware or software.
- If you have made a mistake or must pass the problem on to someone with more expertise, be honest.

In some PC support situations, it is appropriate to consider yourself as a support to the user, as well as to the PC. Your goals may include educating the user as well as repairing the computer. If you want users to learn something from a problem they caused, don't fix the problem yourself unless they ask. Explain how to fix the problem and walk them through the process if necessary. It takes a little longer, but is more productive in the end because the user learns more and is less likely to repeat the mistake.

Here are some helpful questions to ask the user when you are trying to discover the problem:

- When did the problem start?
- Were there any error messages or unusual displays on the screen?
- What programs or software were you using?
- Did you move your computer system recently?
- Has there been a recent thunderstorm or electrical problem?
- Have you made any hardware changes?
- Did you recently install any new software?
- Did you recently change any software configuration setups?
- Has someone else been using your computer recently?

The goal is to gain as much information from the user as you can before investigating the hardware and the software.

Isolate the Problem

After gathering as much information as possible, try to isolate the computer problem. The two most effective approaches are eliminating the unnecessary and trading good for suspected bad.

A+CORE 2.2

Eliminate the Unnecessary This rule can be applied in many ways—for example, when the PC will not boot successfully. In this case, it is often unclear if the problem is with the hardware or software. When using Windows 9x, you can boot into Safe Mode (press F5 at startup) and eliminate much of the OS customized configuration. But if you still have problems, you may be able to boot from your bootable rescue disk.

Boot from a disk that you know is good and that has a minimal OS configuration (i.e., no CONFIG.SYS or AUTOEXEC.BAT files). By doing so you eliminate all the applications software loaded at startup on the PC, all the TSRs loaded at startup, and much of the OS, especially in Windows 9x. If the problem goes away, you can deduce that the problem is with (1) the software on the PC or (2) the hard drive and/or its subsystem that is used as the boot device.

If you suspect the problem is caused by faulty hardware, eliminate any unnecessary hardware devices. If the PC still boots with errors, disconnect the network card, the CD-ROM drive, the mouse, and maybe even the hard drive. You don't need to remove the CD-ROM or hard drive from the bays inside the case. Simply disconnect the data cable and the power cable. Remove the network card from its expansion slot. Remember to place it on an antistatic bag or grounded mat—not on top of the power supply or case. If the problem goes away, you know that one or more of these devices is causing the problem. Replace one at a time until the problem returns. Remember that the problem might be a resource conflict. If the network card worked well until the CD-ROM drive was reconnected, and now neither works, try the CD-ROM drive without the network card. If the CD-ROM drive now works, you most likely have a resource conflict.

Trade Good for Suspected Bad When diagnosing hardware problems, this method works well if you can draw from a group of parts that you know work correctly. Suppose the monitor does not work; it appears dead. The parts of the video subsystem are the video card, the power cord to the monitor, the cord from the monitor to the PC case, and the monitor itself. Also, don't forget that the video card is inserted into an expansion slot on the system board, and the monitor depends on electrical power. Suspect each of these five components to be bad; try them one at a time. Trade the monitor for one that you know works. Trade the power cord, trade the cord to the PC video port, move the video card to a new slot, and trade the video card. When you're trading a good component for a suspected bad one, work methodically by eliminating one component at a time. Don't trade the video card and the monitor and then turn on the PC to determine if they work. It's possible that both the card and the monitor are bad, but first assume that only one component is bad before you consider whether multiple components need trading.

In this situation, suppose you keep trading components in the video subsystem until you have no more variations. Next, take the entire subsystem—video card, cords, and monitor—to a PC that you know works, and plug each of them in. If they work, you have isolated

A+CORE 2.2

the problem to the PC, not the video. Now turn your attention back to the PC—the system board, the software settings within the OS, the **video driver**, etc. Knowing that the video subsystem works on the good PC gives you a valuable tool. Compare the video driver on the good PC to the one on the bad PC. Make certain the CMOS settings, software settings, etc., are the same.

An Alternate Approach to Trading Good for Suspected Bad An alternate approach works well in certain situations. If you have a working PC that is configured similarly to the one you are troubleshooting (a common situation in many corporate or educational environments), rather than trading good for suspected bad, you can trade suspected bad for good. Take each component that you suspect is bad and install it in the working PC. If the component works on the good PC, then you have eliminated it as a suspect. If the working PC breaks down, then you have probably identified the bad component.

TROUBLESHOOTING GUIDELINES

Troubleshooting a PC problem begins with isolating it into one of two categories: problems that prevent the PC from booting and problems that occur after a successful boot. Begin by asking the user the questions listed earlier in this chapter, to learn as much as you can. Next, ask yourself, "Does the PC boot properly?" Figure 8-1 shows you the direction to take, depending on the answer. If the screen is blank and the entire system is "dead"—no lights, spinning drive, or fan, then proceed to troubleshooting the power system.

Recall from Chapter 1 that when POST completes successfully, it sounds a single beep indicating that all is well, regardless of whether the monitor is working or even present. If you hear the beep, then the problem is with the video, and the next step is to troubleshoot it. If you don't hear the beep or you hear more than one, then POST encountered an error. In that case, proceed to troubleshooting the system board.

If an error message appears on the screen, then the obvious next step is to respond to the message. An example of such an error is "Keyboard not present." If the error message occurs as the OS loads, and you don't understand the message or know what to do about it, begin by troubleshooting the OS.

If video is working but the boot message is confusing or unreadable, then begin to eliminate the unnecessary. Perform a clean boot. For Windows 9x, the simplest way is to boot to Safe Mode. If that doesn't work, use your bootable rescue disk.

If the PC boots up properly, turn your attention to the system that is not working and begin troubleshooting there. This chapter covers some of these systems, including the keyboard, video, and printer. Troubleshooting guidelines for other systems are spread throughout the book.

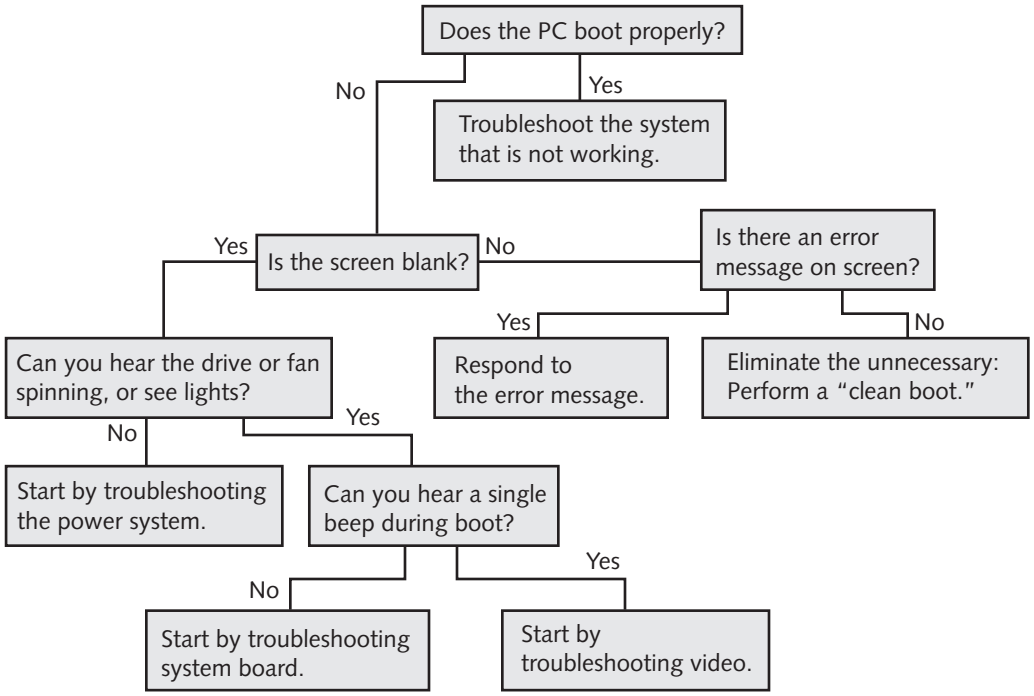

Figure 8-1 Begin PC problem solving by asking the question, "Does the PC boot up properly?"

Troubleshooting the Power System

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If the PC appears "dead," ask these questions:

- Are there any burnt parts or odors? (Definitely not a good sign!)
- Is everything connected and turned on? Any loose cable connections? Is the computer plugged in?
- Are all the switches turned on? Computer? Monitor? Surge protector? Uninterruptible power supply? Separate circuit breaker? Is the wall outlet (or surge protector) good?
- If the fan is not running, turn off the computer, open the case, and check the connections to the power supply. Are they secure? Are all cards securely seated?

Once you have answered these questions, if you still haven't isolated and fixed the problem, proceed this way:

For most of the newer ATX power supplies, a wire runs from the power switch on the front of the ATX case to the system board. This wire must be connected to the pins on the system board and the switch turned on before power comes up. Check that the wire is connected correctly to the system board. Figure 8-2 shows the wire, which is labeled

A+CORE 2.1, 3.2

"REMOTE SW," connected to pins on the system board labeled "PWR.SW." If you are not sure of the correct connection on the system board, see the system-board documentation. Next, check the voltage output from the power supply. (How to do this is covered in Chapter 11.)

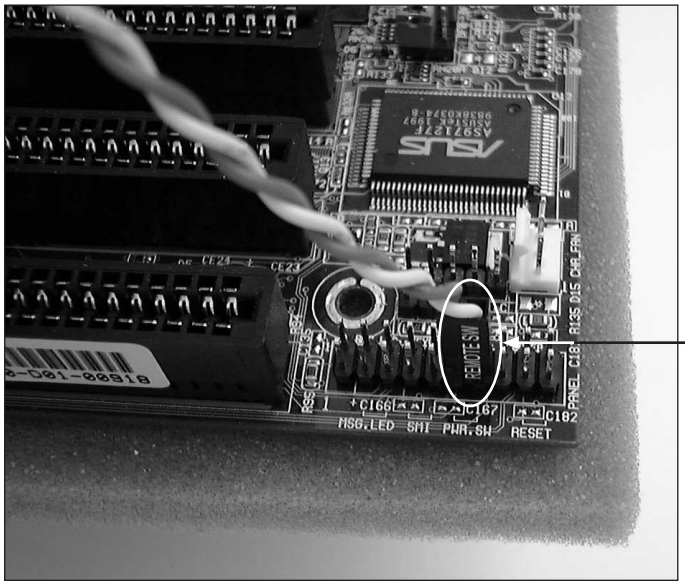

Figure 8-2 For an ATX power supply, the remote switch wire must be connected to the system board before power will come on

Then, remove all nonessential expansion cards (modem, sound card, mouse) one at a time. This verifies that they are not drawing too much power and pulling the system down. It is possible that the expansion cards are all good, but that the power supply cannot provide enough current for all the add-on boards. Perhaps there are too many cards, and the computer is overheating. The temperature inside the case should not exceed 113° F.

Vacuum the entire unit, especially the power supply's fan vent, or use compressed air to blow out the dust. Excessive dust insulates components and causes them to overheat. Use an ESD-safe service vac that can be purchased from electronic tools suppliers.

Trade the power supply for another one that you know is good. For an AT system board, be certain to follow the black-to-black rule when attaching the power cords to the system board.

Is there strong magnetic or electrical interference? Sometimes an old monitor will emit too much static and EMF (electromagnetic force), and bring a whole system down.

Troubleshooting the System Board

A+CORE 2.1

When troubleshooting the system board, use whatever clues POST can give you. Recall that, before video is checked out, POST reports any error messages as beep codes. When a PC boots, one beep indicates that all is well after POST. If you hear more than one beep, look

A+CORE 2.1

up the beep code in Appendix A. Error messages on the screen indicate that video is working. Look up the error message in Appendix A if the message is not clear. If the beep code or error message is not in Appendix A, try the web site of the ROM BIOS manufacturer for information. Figure 8-3 shows the web site for AMI with explanations of beep codes produced by its startup BIOS.

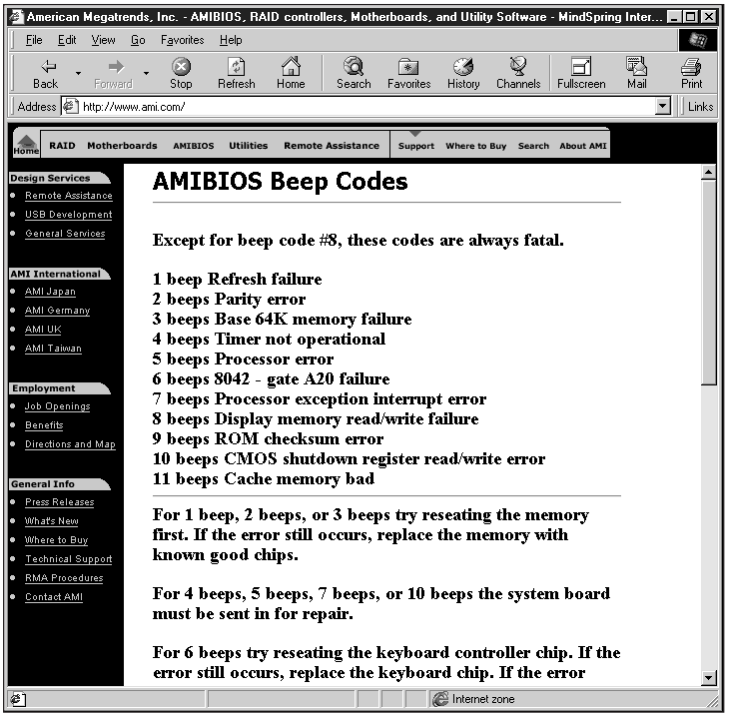

Figure 8-3 The ROM BIOS manufacturer's web site is a good source of information about beep codes

Remember that you can try substituting good hardware components for suspected bad ones. Be cautious here. A friend once had a computer that would not boot. He replaced the hard drive, with no change. He replaced the system board next. The computer booted up with no problem; he was delighted, until it failed again. Later he discovered that a faulty power supply had damaged his original system board. When he traded the bad one for a good one, the new system board also got zapped! Check the voltage coming from the power supply before putting in a new system board!

If the problem isn't improved, ask yourself, "Is the system in a Doze or Sleep Mode?" Many "green" systems can be programmed through CMOS to suspend the monitor or even the drive if the keyboard or CPU have been inactive for a few minutes. Pressing any key will usually resume operations exactly where the user left off.

A+CORE 2.1

If this doesn't resolve the problem, try these things:

- If the fan is running, reseat or replace the CPU, BIOS, or RAM. Try installing RAM in a different slot. A POST code diagnostic card is a great help at this point.
- Sometimes a dead computer can be fixed by simply disassembling it and reseating cables, adapter cards, socketed chips, and SIMMs and DIMMs. Bad connections and corrosion are common problems.
- Check jumpers, DIP switches, and CMOS settings. Look for physical damage on the system board.
- If the battery is dead, or dying, it may cause problems. Sometimes, after a long holiday, a weak battery will cause the CMOS to forget its configuration.
- Reduce the system to essentials. Remove any unnecessary hardware, such as expansion cards, and then try to boot again.
- Exchange the system board, but before you do, measure the voltage output of the power supply in case it is producing too much power and has damaged the board.

The computer does not recognize all installed RAM or SIMMs

When the computer does not recognize all installed RAM or SIMMs, take the steps and answer the questions below:

- Are CMOS settings correct?
- Run diagnostic software such as PC-Technician to test memory.
- Are SIMM or DIMM modules properly seated? Remove and reinstall each one. For a DIMM module, try a different memory slot.
- Look for bent pins or chips installed the wrong way on cache memory.
- Place your fingers on the individual chips. Sometimes a bad chip may be noticeably hotter than the others.
- Make sure the SIMMs have correct or consistent part numbers. For example, if there are four installed SIMMs, they usually must be the same size (in megabytes) and same speed (in nanoseconds).
- Replace memory modules one at a time. For example, if the system only recognizes six out of eight megabytes of RAM, swap the last two SIMM modules. Did the amount of recognized RAM change? You might be able to solve the problem just by reseating the modules. Use SIMM modules with the same part number. Chapter 4 has more information about choosing the correct SIMMs or DIMMs for a system board.
- Sometimes a problem can result from a bad socket or a broken trace (a fine printed wire or circuit) on the system board. If so, you might have to replace the entire system board.
- A Windows error that occurs randomly and contains this or similar text, "exception fault 0E at >> 0137:BFF9a5d0", probably indicates a memory error. Test, reseat or replace RAM.

Troubleshooting the Operating System and Hard Drive

A+CORE 2.1

To troubleshoot the OS and hard drive, proceed as follows:

- Try a hard boot. A soft boot might not do the trick, because TSRs are not always "kicked out" of RAM with a soft boot.
- Learn to use the Windows 9x Startup Menu, which is described in other chapters and has the options displayed in Figure 8-4. Option 4 is displayed if the PC is configured for a network, and Option 8 is displayed if an earlier version of DOS is installed. Try Safe Mode first. If that doesn't work, use the step-by-step confirmation to identify the command causing the problem. Use the Logged option and examine the BOOTLOG.TXT file created. Try booting to just the command prompt. If nothing works, boot from the Windows 9x rescue disk or from a rescue disk created by utility software such as Nuts & Bolts or Norton Utilities.

1. Normal	5. Step-by-step confirmation
2. Logged (\BOOTLOG.TXT)	6. Command prompt only
3. Safe Mode	7. Safe Mode command prompt only
4. Safe Mode with network support	8. Previous version of MS-DOS
	Enter a Choice: 1

Figure 8-4 Windows 9x Startup Menu is displayed when you press F8 during startup

- When you boot from a floppy disk, you should boot to an A prompt. If you are successful, the problem is in the hard drive subsystem and/or the software on the drive.
- Can you access the hard drive from the A prompt? If you can get a C prompt, then the problem is in the software used on the hard drive to boot, including the partition table, master boot record, OS hidden files, and command interface files. See Chapter 7 for help diagnosing hard drive problems.
- Run diagnostic software to test for hard drive hardware problems.
- An error that contains the text "Kernel32.dll" probably indicates a corrupted kernel. Try restoring system files. If that doesn't work, reinstall Windows. More about this in Chapter 12.

Problems after the Computer Boots

Either hardware or software can cause problems after the computer boots.

- If you suspect the software, try diagnostic software such as Nuts & Bolts, ScanDisk, or Norton Utilities before reloading the software package. See Chapter 12 for more suggestions on diagnosing software problems.
- If you suspect the hardware, first isolate the problem by removing devices and substituting good components for suspected bad ones. Be aware that the problem might be a resource conflict.

- Check the voltage output from the power supply with a multimeter (to be covered in Chapter 11).
- Check jumpers, DIP switches, and CMOS settings for the devices.
- Suspect a corrupted device driver. Reinstall the driver.
- Suspect the applications software using the device. Try another application or reinstall the software.

A+ OS 2.4

Problems with the Software

Suppose the computer boots with no errors, and all but one software package on this computer work correctly. When you try to load the problem software package, however, you get an error message and the software terminates. If so, you can probably conclude that the software caused the error. Ask yourself: Has this software ever worked? If it has not, then try installing it again. Maybe wrong information was given during the installation. Be sure you check the requirements for the software. Maybe you don't have enough memory or space on your hard drive to create the necessary working files.

When was the last time the software worked? What happened differently then? Did you get an error message that seemed insignificant at the time? What has happened to your computer since the software last worked? Have you added more software or changed the hardware configuration?

Reinstalling software Consider reinstalling the software even if it has worked in the past. Maybe a program file has become corrupted. Before you reinstall, however, ask yourself, "If I reinstall it will I erase data that this software has placed on my hard drive?" If you're not sure, back up the data. Maybe you can just copy the data to another directory while you reinstall the program. If the installation does erase the data in the original directory, you can copy one file and then another back to the original directory. If the problem reoccurs, then you've found the corrupted data file that caused the problem.

Software often uses configuration files and scripting files that are specific to a particular PC or user. If you reinstall the software, most likely you will lose the configuration information. Either save the configuration files before you begin or print the contents of the files. See the software documentation for the names and location of the configuration files (a file extension of .cfg is common). Consider that the problem with the software might be a corrupted configuration file.

If a particular software package doesn't work and everything else does, the problem might not be with the software. One user could not get a software package to work on his machine after many installation attempts. The video displayed only a blank screen. All other software worked properly on his computer, which he had purchased one year earlier. It was shipped as a complete system directly from the manufacturer and was equipped with a super VGA color monitor. During the software installation, the user correctly told the software to interface with a super VGA video card. After many phone calls to technical support at both the software and hardware companies, the problem was finally identified. The manufacturer had mistakenly sent him a computer with a super VGA monitor but a VGA (not super VGA)

A+ OS 2.4

video card. All the other software packages interfaced with the VGA card with no problems, but this one was more discriminating.

This is a case where Nuts & Bolts, Norton Utilities, or similar utility software could have helped. These utilities can display system hardware information and tell you what type of video card you have.

Problems Caused by Other Software

Software problems might be caused by other software. Windows 3.x and Windows 9x use files stored in the \Windows\System directory to support software files for many applications as well as Windows. These files can have extensions of .dll, .ocx, .oca, .vbx, etc. The most common are the DLL (dynamic-link library) files. Figure 8-5 shows the results of a search for these files on a hard drive: 938 DLL files were located. These files perform tasks for many software packages, such as displaying and managing a dialog box on screen. When you install an application, the installation program may write a DLL to the \Windows\System directory and overwrite an earlier version of the DLL used by another application. The original application may have problems because it cannot use the new DLL. If the software being investigated started to have problems after you installed another software program, the problem may well be the DLL it is unsuccessfully trying to use. Chapter 12 discusses solving DLL problems and similar difficulties created by "bad neighbor" software.

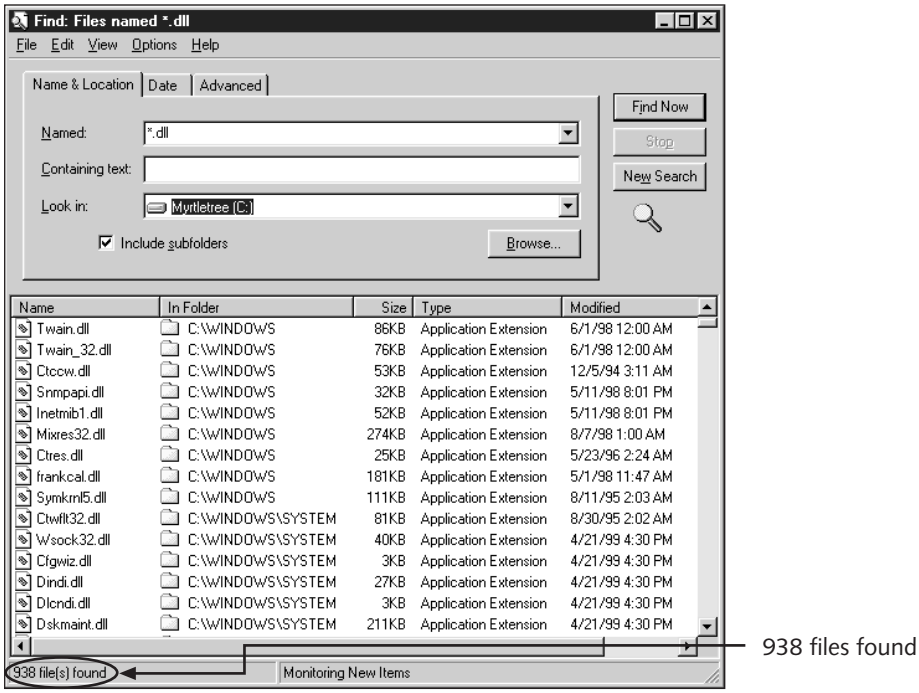

Figure 8-5 DLL files can be shared by several applications, which can be a source of problems with software

A+ OS 2.4

CORE 2.2

Intermittent Problems

Intermittent problems can make troubleshooting challenging. The trick in diagnosing problems that come and go is to look for patterns or clues as to when the problems appear. If you or the user can't reproduce the problem at will, ask the user to keep a log of when the problems occur and exactly what messages appear. Show the user how to get a printed screen of the error messages when they appear. Here's the method:

- For simple DOS systems, the Print Screen key directs the displayed screen to the printer.
- In Windows, the Print Screen key copies the displayed screen to the Clipboard.
- Launch the Paint software accessory program and paste the contents of the Clipboard into the document. You might need to use the Zoom Out command on the document first. You can then print the document with the displayed screen, using Paint. You can also paste the contents of the Clipboard into a document created by a word-processing application such as Word.

Problems with the Keyboard and Monitor

A+ CORE 3.1

If peripheral devices such as a keyboard or monitor don't work, ask questions like these: Does the device work in situations other than the current one? Perhaps the problem is with the applications software interfacing with the device, rather than with the device itself. Has the device ever worked? Will another device work in this same situation? Exchange the keyboard or monitor for one you know works. If the good device now fails to work, you can eliminate the original device as the source of the problem. The problem must be the software, the cable, the computer, or the user. Check all connections and exchange cables.

Troubleshooting Keyboard Problems

Often dirt, food, or drink in the keyboard causes one or more keys to stick or not work properly. Because of their low cost, the solution for a keyboard that doesn't work is most often to replace it. However, you can try a few simple things to repair one that is not working.

A few keys don't work If a few keys don't work, remove the caps on the bad keys with a chip extractor. Spray contact cleaner into the key well. Repeatedly depress the contact in order to clear it out. Don't use rubbing alcohol to clean the key well, because it can leave a residue on the contact. If this method of cleaning solves the problem, then clean the adjacent keys as well.

Turning the keyboard upside down and lightly bumping multiple keys with your flat palm will help loosen and remove debris.

The keyboard does not work at all If the keyboard does not work at all, first determine that the cable is plugged in. PC keyboard cables may become loose or disconnected.

If the cable connection is good and the keyboard still does not work, swap it with another keyboard of the same type that you know is in good condition, to verify that the problem is in the keyboard and not in the computer.

A+CORE 3.1

If the problem is in the keyboard, check the cable. If possible, swap the cable with a known good one, perhaps from an old discarded keyboard. Sometimes a wire in a PC keyboard cable becomes pinched or broken. Most cables can be easily detached from the keyboard by removing the few screws that hold the keyboard case together, then simply unplugging the cable. Be careful as you work; don't allow the key caps to fall out! In Chapter 11 you will learn how to use a multimeter to test a cable. This test is called a continuity test.

On the system board, the two chips that affect the keyboard functions are the keyboard chip and the ROM BIOS chip. You might choose to replace each of these chips on the system board. Otherwise the entire system board might have to be replaced.

Key continues to repeat after being released This problem can be caused by a dirty contact. Some debris may have conductive properties, short the gap between the contacts, and therefore cause the key to repeat. Try cleaning the key switch with contact cleaner.

Very high humidity and excess moisture will sometimes short key switch contacts and cause keys to repeat, because water is an electrical conductor. The problem will usually resolve itself once the humidity level returns to normal. You can hasten the drying process by using a fan (not a hot hair dryer) to blow air at the keyboard.

Keys produce the wrong characters This problem is usually caused by a bad chip. PC keyboards actually have a processor mounted on the logic board inside the keyboard. Try swapping the keyboard for one you know is good. It the problem goes away, replace the keyboard.

Major spills on the keyboard When coffee or other drinks with sugar in them spill on the keyboard, they create a sticky mess. The best solution is to thoroughly rinse the keyboard in running water, such as a bathroom shower. Make sure the keyboard dries thoroughly before you use it. Let it dry for two days on its own, or less if you set it out in the sun or in front of a fan.

A+CORE 2.1

Troubleshooting Monitor Problems

For monitors, as well as other devices, do the easy things first. Make simple hardware and software adjustments. Also, remember the "trade good for suspected bad" method. Many monitor problems are caused by poor cable connections or bad contrast/brightness adjustments. Also check if the monitor is still under warranty. Remember that many warranties are voided if an unauthorized individual works inside the monitor. Typical monitor problems and how to troubleshoot them are described next:

Power light (LED) does not go on, no picture Is the monitor plugged in? Verify that the wall outlet works by plugging in a lamp, radio, etc.

If the monitor power cord is plugged into a power strip or surge protector, verify that the power strip is turned on and working and that the monitor is also turned on. Look for an on/off switch on the front and back of the monitor. Some monitors have both.

A+CORE 2.1

If the monitor power cord is plugged into the back of the computer, verify that the connection is tight and the computer is turned on.

A blown fuse could be the problem. Some monitors have a fuse that is visible from the back of the monitor. It looks like a black knob that you can remove (no need to go inside the monitor cover). Remove the fuse and look for the broken wire indicating a bad fuse.

The monitor may have a switch on the back for choosing between 110 volts and 220 volts. Check that the switch is in the right position.

If none of these solutions solves the problem, the next step is to take the monitor to a service center.

Power LED light is on, no picture on power-up Check the contrast adjustment. If there's no change, then leave it at a middle setting.

- Check the brightness adjustment. If there's no change, then leave it at a middle setting.
- Is the cable connected securely to the computer?
- If the monitor-to-computer cable detaches from the monitor, exchange it for a cable you know is good or check the cable for continuity (Chapter 11).
- If this solves the problem, reattach the old cable to verify that the problem was not simply a bad connection.
- Confirm that the proper system configuration has been set up. Some older system boards have a jumper or DIP switch you can use to select the monitor type.
- Test a monitor you know is good on the computer you suspect to be bad. Do this and the previous step to identify the problem. If you think the monitor is bad, make sure that it also fails to work on a good computer.
- Check the CMOS settings or software configuration on the computer. When using Windows 9x, boot into Safe Mode (press F5 during the boot) to allow the OS to select a generic display driver and low resolution. If this works, change the driver and resolution. You will learn more about this in Chapter 12.
- Reseat the video card. Move the card to a different expansion slot. Clean the card's edge connectors using a contact cleaner or a white eraser. Do not let crumbs from the eraser fall into the expansion slot.
- If there are socketed chips on the video card, remove the card from the expansion slot and, using a screwdriver, press down firmly on each corner of each socketed chip on the card. Chips sometimes loosen because of thermal changes; this condition is called chip creep.
- Trade a good video card for the video card you suspect is bad. Test the video card you think is bad on a computer that works. Test a video card you know is good on the computer that you suspect may be bad. Whenever possible, do both.
- If the video card has socketed chips that appear dirty or corroded, consider removing them and trying to clean the pins. You can use a clean pencil eraser to

A+CORE 2.1

do this. Normally, however, if the problem is a bad video card, the most cost-effective measure is to replace the card.

- Go into setup and disable the shadowing of video ROM.
- Test the RAM on the system board with diagnostic software.
- For an older system board that supports both VESA and PCI, if you are using a VESA video card, try using a PCI card.
- Trade the system board for one you know is good. Sometimes, though rarely, a peripheral chip on the system board of the computer can cause the problem.

Power on, but monitor displays the wrong characters Wrong characters are usually not the result of a bad monitor but of a problem with the video card. Trade the video card for one you know is good.

Exchange the system board. Sometimes a bad ROM or RAM chip on the system board displays the wrong characters on the monitor.

Monitor flickers and/or has wavy lines Monitor flicker can be caused by poor cable connections. Check that the cable connections are snug.

- Does the monitor have a degauss button to eliminate accumulated or stray magnetic fields? If so, press it.
- Check if something in the office is causing a high amount of electrical noise. For example, you might be able to stop a flicker by moving the office fan to a different outlet. Bad fluorescent lights or large speakers can also produce interference. Two monitors placed very close together can also cause problems.
- If the vertical scan frequency (the refresh rate at which the screen is drawn) is below 60 Hz, a screen flicker may appear.
- Use a different refresh rate. In Windows 9x, right-click the desktop and select **Properties** from the menu.
- For older monitors that do not support a high enough refresh rate, your only cure may be to purchase a new monitor.
- Before making a purchase, verify that the new monitor will solve the problem.

Check **Control Panel**, **Display**, **Settings** to see if a high resolution (greater than 800 × 600 with more than 256 colors) is selected. Consider these issues:

1. The video card might not support this resolution/color setting.
2. There might not be enough video RAM; 2 MB or more may be required.
3. The added (socketed) video RAM might be of a different speed than the soldered memory.

A+CORE 2.1

No graphics display or the screen goes blank when loading certain programs This problem may be caused by the following:

- A special graphics or video accelerator card is not present, or is defective.
- Software is not configured to do graphics, or the software does not recognize the installed graphics card.
- The video card does not support the resolution and/or color setting.
- There might not be enough video RAM; 2 MB or more might be required.
- The added (socketed) video RAM might be of a different speed than the soldered memory.
- The wrong adapter/display type is selected. Start Windows 9x from Safe Mode to reset the display. (How to do this is explained later in this discussion.)

Screen goes blank 30 seconds or one minute after the keyboard is left untouched A "green" system board (one that follows energy-saving standards) used with an Energy Saver monitor can be configured to go into a Standby or Doze Mode after a period of inactivity. This might be the case if the monitor resumes after you press a key or move the mouse. Doze times can be set for periods from as short as 20 seconds to as long as one hour. The power LED light normally changes from green to orange to indicate Doze Mode. Monitors and video cards using these energy-saving features are addressed in Chapter 9.

You might be able to change the doze features by entering the CMOS menu and looking for an option such as Power Management, or in Windows 9x by opening the **Control Panel** and selecting **Display**, **Screen Saver**.

Some monitors have a Power Save switch on the back of the monitor. Make sure this is set as you want.

Poor quality color display For this problem, try the following:

- Read the documentation for the monitor to learn how to use the color-adjusting buttons to fine-tune the color.
- Exchange video cards.
- Add more video RAM; 2 MB or 4 MB might be required for higher resolutions.
- Check if a fan or large speaker (speakers have large magnets) or another monitor nearby could be causing interference.

Picture out of focus or out of adjustment For this problem, try the following:

- Check the adjustment knobs on the control panel on the outside of the monitor.
- Change the refresh rate. Sometimes this can make the picture appear more in focus.
- You can also make adjustments inside the monitor that might solve the problem. If you have not been trained to work inside the monitor, take the monitor to a service center.

A+CORE 2.1

Crackling sound An accumulation of dirt or dust inside the unit might be the cause. Someone trained to work on the inside of the monitor can vacuum the inside.

To configure or change monitor settings and drivers in Windows 9x If the video card is supported by Windows 9x, you can change the driver and settings by double-clicking the **Display** icon in the **Control Panel**. For drivers not supported by Windows 9x, you can reinstall the drivers by using the CD or floppy disks that come with the video card. The settings for this type of driver can most likely be changed through the Control Panel's Display icon.

To change the video driver configuration Double-click the Display icon in the Control Panel. Select the Settings tab to change the color palette, resolution (for example, from 800 x 600 to 1024 x 768), or the driver for the video card or monitor type. Click Advanced on the Settings tab to show the Change Display Type window (see Figure 8-6). From this window, you can change the video card or the monitor type.

If you increase the resolution, the Windows icons and desktop text become smaller. Select **Large Fonts** on the Settings tab and increase the **Desktop Icon size** on the Appearance tab.

Returning to standard VGA settings When the display settings don't work, return to standard VGA settings as follows:

- For Windows 9x, reboot the system and press the F8 key after the first beep.
- When the Microsoft Windows 9x Startup Menu appears, select **Safe Mode** to boot up with minimal configurations and standard VGA display mode.
- Double-click the **Display** icon in the **Control Panel** and reset to the correct video configuration.

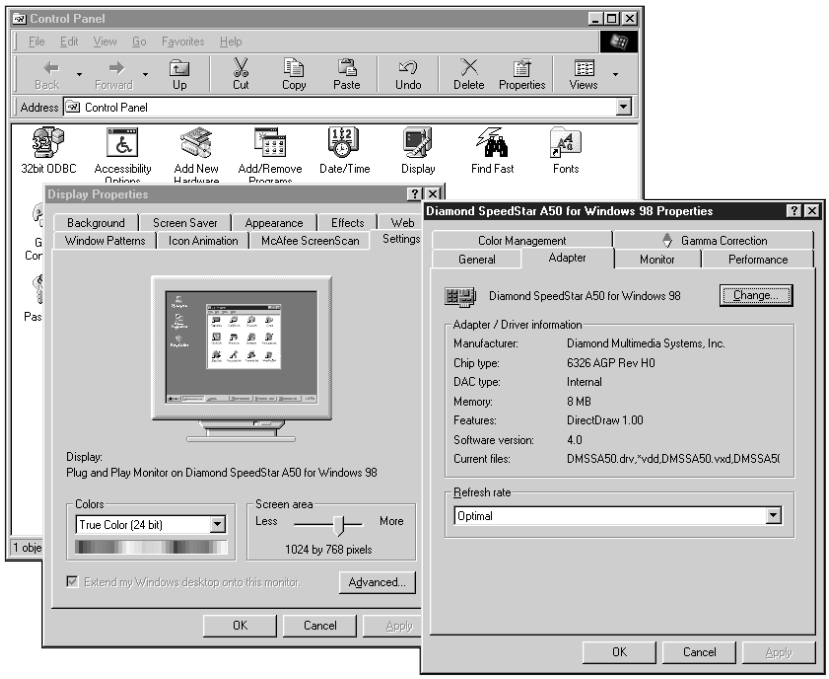

Figure 8-6 Changing the video card type in Windows 95 or Windows 98

Troubleshooting Printer Problems

A+CORE 5.2

When troubleshooting printer problems, first determine that the problem is truly with the printer. The problem might be the computer hardware communicating with the printer, the applications software using the printer, the printer driver, the printer cable, or the printer. Ask these questions and try these things:

- Is the printer turned on and online?
- Is the correct printer selected as the default printer?
- Can an applications software program other than the current program use the printer?
- Is the printer using the correct driver? Does the driver need updating? Is the driver correctly installed?
- Can you move the printer to another computer and print from it? Will another printer work on this computer?

Once you are convinced that the problem is not with the computer hardware or software, but is indeed a problem with the printer itself, you are ready for the following troubleshooting guide.

Laser Printer Problems

The printer documentation can be very helpful and most often contains a phone number to technical support for the printer manufacturer. A good test for a printer is to print the manufacturer's test page from the PC, not just directly from the printer. For example, using Windows 98, for an HP LaserJet 5L, access the **Control Panel** and double-click **Printers**. In the Printers window, right-click the printer you want to test. You see the shortcut menu shown in Figure 8-7. Select the **Properties** option. The Properties dialog box is displayed as in Figure 8-8. Click **Print Test Page** to send a test page to the printer.

Figure 8-7 Control menu for an installed printer

A+CORE 5.2

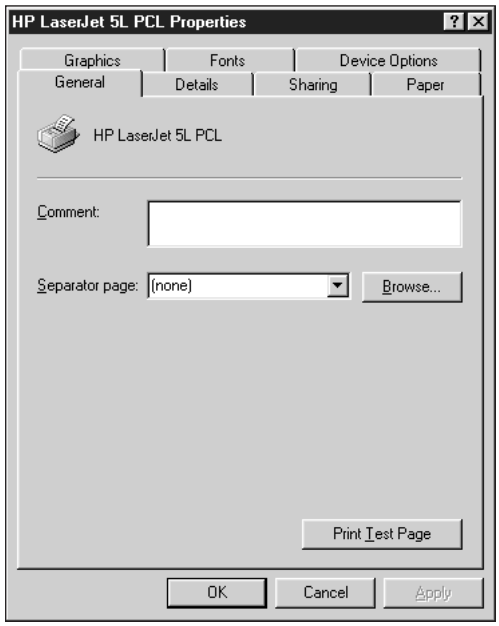

Figure 8-8 The properties box for an installed printer allows you to print a test page

Printer never leaves warm-up mode The warming up message should go off as soon as the printer establishes communication with the PC. If this doesn't happen, try the following:

- Turn the printer off and disconnect the cable to the computer.
- Turn on the printer. If it now displays a Ready message, the problem is communication.
- Verify that the cable is connected to the correct printer port, not to a serial port.
- Verify that data to the installed printer is being sent to the parallel port. For example, open the Properties dialog box of the installed printer as described above. Verify that the print job is being sent to LPT1, as shown in Figure 8-9.

A+CORE 5.1, 5.2

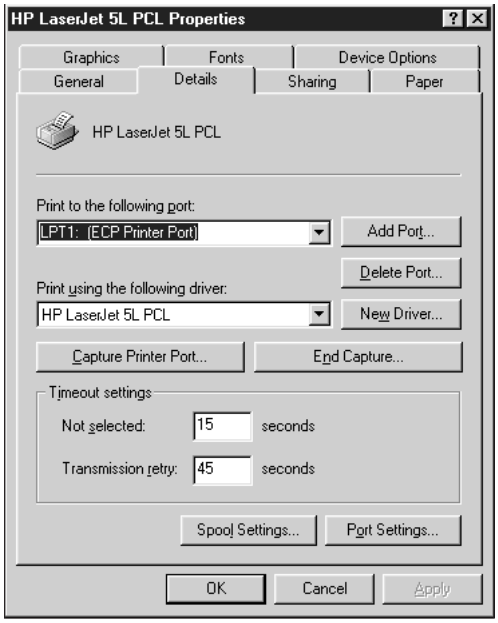

Figure 8-9 Verify that print data is being sent to the correct parallel port

Check that the parallel port is enabled in CMOS setup and is set to the correct mode. More about parallel port modes in the next chapter.

Replace the cable.

A Paper Out message is displayed Remove the paper tray. Be sure there is paper in the tray. Carefully replace the tray, being certain the tray is fully inserted in the slot.

Check the lever mechanism that falls into a slot on the tray when no paper is present. Is it jammed or bent?

A Toner Low message is displayed, or print is irregular or light Remove the toner cartridge from the printer, tap the cartridge to redistribute the toner supply, and replace it in the printer. Don't shake the cartridge too hard, to avoid flying toner. This is really just a temporary fix for a cartridge low on toner. Eventually the user must put a new toner cartridge in the printer. Extreme humidity may cause the toner to clump in the cartridge and give the same error message.

A Paper Jam message is displayed If paper is jammed inside the printer, follow the directions in the printer documentation to remove the paper. Don't jerk the paper from the printer mechanism, but pull evenly on the paper, with care.

If there is no jammed paper, then remove the tray and check the metal plate at the bottom of the tray. Can it move up and down freely? If not, replace the tray.

When you insert the tray in the printer, does the printer lift the plate as the tray is inserted? If not, the lift mechanism might need repairing.

A+CORE 5.1, 5.2

One or more white streaks appear in the print Remove the toner cartridge, tap it to redistribute the toner supply, and replace the cartridge. Check the printer manual for specific directions as to what part might need replacing if this problem occurs.

Print appears speckled Try replacing the toner cartridge. If the problem continues, the power supply assembly might be damaged.

Printed images are distorted Check for debris that might be interfering with the printer operation.

Replace the toner cartridge.

Dot Matrix Printer Problems

Here is a troubleshooting guide for dot matrix printers:

Print quality is poor Begin with the ribbon. Does it advance normally while the carriage moves back and forth? Replace the ribbon.

If the new ribbon still does not advance properly, check the printer's advance mechanism.

Adjust the print head spacing. Look for a lever adjustment you can use to change the distance between the print head and plate.

Check the print head for dirt. Make sure it's not hot before you touch it. If debris has built up, wipe each wire with a cotton swab dipped in alcohol or contact cleaner.

Printer self-test works, but printing from a computer application does not work To perform a printer self-test, see the printer documentation. This test ensures that the printer itself is functioning correctly, and that the problem is communication from the PC.

Check cable connections. Is the printer online?

Print head moves back and forth, but nothing prints Check the ribbon. Is it installed correctly between the plate and print head?

Does the ribbon advance properly?

Ink-Jet Printers

Here is a troubleshooting guide for ink-jet printers:

Print quality is poor Is the correct paper for ink-jet printers being used?

Is the ink supply low, or is there a partially clogged nozzle?

Remove and reinstall the cartridge.

Follow the printer's documentation to clean each nozzle.

In the Printer Setup dialog box, click the **Media/Quality** tab, then change the **Print Quality** selection. Try different settings with sample prints.

A+CORE 5.2

Is the print head too close to or too far from the paper?

If you are printing on transparencies, try changing the fill pattern in your application.

Printing is intermittent or absent Is the ink supply low?

Are nozzles clogged?

Replace the ink cartridges or replenish the ink supply.

When a PC Is Your Permanent Responsibility

When you are the person responsible for a PC, either as the user or as the ongoing support person for the PC and the user, prepare for future troubleshooting situations. This section describes these tasks and procedures.

Accurate records of the configuration data on a PC, the hardware, the software, and the data are essential to effective troubleshooting. Make these records, or teach the user to make them, when all is well. Keep documentation on hardware and software in an easy-to-find location. Prepare a bootable disk that contains copies of the necessary startup files on the hard drive specific to this PC. Organize the hard drive to keep the number of files in the root directory to a minimum.

Organize the Hard Drive Root Directory

In the root directory, keep only startup files for your system and necessary initialization files for the software. Software applications or files containing data don't belong in the root directory, although these applications will sometimes put initialization files in the root directory to be used when they first load. Keep applications software and their data in separate directories.

Filenames and extensions can help identify files that applications software puts in the root directory to initialize itself. For example, PRODIGY.BAT is a DOS batch file that the Prodigy software uses to execute. Other software packages often use .BAT files for this same purpose. Other file extensions to look for as initialization files are .ini, .bin, and .dat. If you are not sure of the purpose of one of these files, leave it in the root directory. Some software packages might not work if their file isn't in the root directory. Also, it is common to find a mouse driver file, such as MOUSE.SYS, in the root directory. Don't move it unless you understand how to edit the CONFIG.SYS file to assign a path to this driver file.

In general, keep only a few utility-type files in the root directory on your hard drive. Remember to avoid storing data files or applications software in the root directory. Keep the number of files in the root directory to a minimum.

Create a Boot or Rescue Disk

After you have cleaned up the root directory, make a bootable system disk for DOS, and for Windows 9x make a rescue disk, as discussed in Chapter 2. Test your bootable disk to make sure that it works; label it with the computer model, date, and OS version, and keep it available

at the PC. If you accidentally erase the files in the drive C root directory, you can boot up from drive A and restore the files to the hard drive from this disk.

Documentation

When you first set up a new computer, start a record book about this computer, using either a file on disk or a notebook dedicated to this machine. In this notebook or file, record any changes in setup data as well as any problems or maintenance that you do on this computer. Be diligent in keeping this notebook up to date, because it will be invaluable in diagnosing problems and upgrading the equipment. Keep a printed or handwritten record of all setup data for this machine, and store this with the hardware and software **documentation**.

If you are not the primary user of the computer, you might want to keep the hardware documentation separate from the computer itself. Label the documentation so that you can easily identify that it belongs to this computer. Some support people tape a large envelope inside the computer case, containing important documentation and records specific to that computer. Keep the software reference manuals in a location that is convenient for users.

Record of Setup Data

Keep a record of CMOS showing hard drive type, drive configuration, and so on. Use a CMOS save program similar to the one discussed in Chapter 3, or use Nuts & Bolts, Norton Utilities, or similar utility software to save the setup data to a floppy disk. This information should be stored on a floppy disk along with the software necessary to use it. Label the disk with the PC type, date, and any information needed to use the disk. Put the disk in a safe place.

If you don't have access to software to save setup, use the print screen key to print the setup screens. If the print screen key does not work while viewing setup on the PC, carefully copy down all settings on paper. On many machines there is an advanced CMOS setup screen. Copy that screen as well, even though you might never expect to change these advanced settings yourself. CMOS can lose these settings, and you will want to be able to reconstruct them when necessary. Also keep a record of DIP switch settings and jumper settings on the system board. You can record these settings the first time you remove the cover of the machine. At the very least, record the settings before you change them! Keep all this information in your notebook.

When installing expansion cards, write down in your notebook information about the card, and keep the documentation that came with it in your notebook. If you must change jumper settings or DIP switches on the card, be certain to write down the original settings before you change anything. When the card is configured correctly, write down the correct settings in your notebook or on the documentation for the card. It is unlikely that a user will accidentally change these settings and then ask you to fix them, but you never know!

Practical Precautions to Protect Software and Data

If software files become corrupted, the most thorough approach is to restore the software from backups or to reinstall the software. To simplify both of these time-consuming tasks, here are a few suggestions:

Before you install a new software package, back up the configuration files for DOS and Windows 3.x or make a backup of the Windows 9x Registry and the Windows 9x configuration files.

Because many software packages overwrite files in the \Windows\System directory during installation, if you have the hard drive space, back up this entire directory before you begin an installation.

Don't compress your hard drive, because compressed drives are more likely to become corrupted than those that are not compressed.

Don't store data files in the same directory as the software, so that there will be less chance of accidentally deleting or overwriting a software file.

At the very least, before beginning an installation, create a folder for the Windows 9x files that are likely to be altered during an application installation and back up these files to that folder. Figure 8-10 shows an example of such a folder, named Win-ini.bak. Store in this folder these files: Win.ini, System.ini, User.dat, and System.dat. The last two files make up the Windows 9x Registry, which is discussed in Chapter 12.

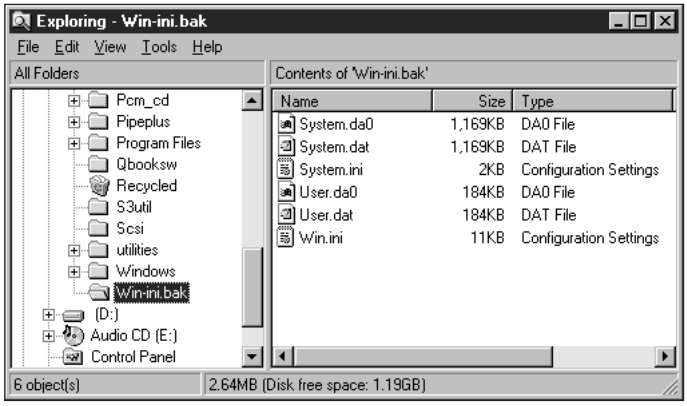

Figure 8-10 Back up Windows 9x files that are likely to be altered during an installation

Back Up Original Software

Many software packages today come stored on CD-ROM, which cannot be backed up easily. If you request a copy of the software on floppy disks, this can serve as your backup. If the software only comes on disk, most software copyright agreements allow the user to make a backup copy of the original disks. The copyright most likely does not allow you to distribute

these backup copies to friends, but you can keep your copy in a safe place in the event that something happens to the originals. Many installation procedures that come with software on disk suggest that you make backup copies and then use the copy for the installation rather than using the original. To make an exact duplicate of a disk, use the Copy Disk command in Windows 9x or Windows 3.x or the DISKCOPY command in DOS.

Back Up Data on the Hard Drive

Don't expect the worst but prepare for it! If important data is kept on the hard drive, back up that data on a regular basis to tape (using utility software designed for that purpose), to removable hard drives, to floppy disks, or to a company file server. The procedures and methods for keeping good backups are beyond the scope of this chapter, but the principle needs stating: don't keep important data on only one medium.

Chapter Summary

- While you are working on a computer, protect the computer and its components against ESD.
- Tools for solving computer problems include a repair kit, bootable disk, and diagnostic hardware and software.
- Two important rules when troubleshooting are to eliminate unnecessary hardware and software and to trade components you know are good for those you suspect may be bad.
- Learn to ask the user good questions (using good manners and diplomacy) that help you understand the history behind the problem.
- One good method of solving intermittent problems is to keep a log of when they occur.
- Troubleshooting keyboards, monitors, and printers should follow the general guidelines listed in the chapter.
- Problems with computers can be divided into two groups: the computer boots or it does not boot.
- Diagnostic cards give error codes based on POST errors.
- Diagnostic software performs many tests on a PC. Some of these software programs use their own proprietary operating systems.
- Utility software can update and repair device drivers and applications. Some utility software downloads these updates from the Internet.
- Keep a bootable disk containing the root directory files of your system.
- Keep backups of hard drive data and software.
- Protect documentation by keeping it in a safe place.
- Keep a written record of CMOS setup or save it on disk.

Key Terms

Bootable disk — For DOS, a floppy disk that can upload the OS files necessary for computer startup. It must have the two hidden system files IO.SYS and MSDOS.SYS, and also COMMAND.COM.

Diagnostic cards — Adapter cards designed to discover and report computer errors and conflicts at POST time (before the computer boots up), often by displaying a number on the card.

Diagnostic software — Utility programs that help troubleshoot computer systems. Some DOS diagnostic utilities are CHKDSK and SCANDISK. PC-Technician is an example of a third-party diagnostic program.

Documentation — Manuals, tutorials, and Help files that provide information that a user needs in order to use a computer system or software application.

Electrostatic discharge (ESD) — Another name for static electricity, which can damage chips and destroy system boards, even though it might not be felt or seen with the naked eye.

Ground bracelet — An antistatic wrist strap used to dissipate static electricity. Typically grounded by attaching an alligator clip to the computer chassis or to a nearby ground mat.

Ground mat — An antistatic mat designed for electronic workbenches to dissipate static electricity. It often uses a wire attached to the ground connection in an electrical outlet.

Static electricity — *See* Electrostatic discharge.

Video driver — A program that tells the computer how to effectively communicate with the video adapter card and monitor. It is often found on a floppy disk that is shipped with the card.

Review Questions

1. Explain how to use a POST diagnostic card.
2. In Windows 9x, what key do you press to enter Safe Mode at startup?
3. Name two antivirus software packages. Why should you run a virus scan on the bootable disk that you use for troubleshooting?
4. List three good questions to ask a user when you are trying to discover a problem.
5. When a PC does not recognize all installed RAM, what are three things you can do?
6. List three things to do if you get the message "Unable to write to C:".
7. List three symptoms that might indicate that a virus is present.
8. Using the rule "trade good for suspected bad," describe how to easily troubleshoot a video problem.
9. Give five possible questions that should be asked of a user who is experiencing computer problems.
10. What are DLL files and why could they cause problems?

11. What is the best way to document intermittent problems?
12. List the steps to get a printed screen of an error message using Windows.
13. Starting with the easiest procedures, list five things to check if a monitor does not display a picture.
14. Identify three things that may cause monitor flicker.
15. What is the value of installing additional video RAM?
16. Starting with the easiest procedures, list five things to check if your printer does not print.
17. What can you do to temporarily solve streaking or light printing on a laser printer?
18. Starting with the easiest procedures, list five things to check if your PC does not boot.
19. Identify three things to check if your PC does not recognize all of the installed memory.
20. What is the rule to follow when connecting the power supply leads (P8 and P9) to the system board?
21. Using the Windows Control Panel or Windows 9x My Computer, System Properties, Device Manager, determine what specific controller (and/or driver) is used for your home or lab monitor.
22. Using the Windows Control Panel or the Windows 9x My Computer, System Properties, Device Manager, determine what specific controller (and/or driver) is used for your home or lab printer.
23. Describe what to do if you've just spilled soda pop on your keyboard.
24. Describe what to do to check that chips on a video card are properly seated in their sockets.
25. In Windows 9x, when troubleshooting problems with a monitor, why would you enter Safe Mode?
26. As a help-desk technician, list some good "detective" questions to ask if the user calls to say, "My PC won't boot."
27. A user calls your help desk complaining that a printer does not work. The printer power light is on, but the PC cannot send a print job to it. What questions do you ask?
28. With the printer problem in Question 27, you suspect that the cable is not correctly connected. List the directions to walk the user through checking the printer cable connections.
29. You are a support technician working at a user site. A user has just erased all the files in the root directory of a PC using DOS and Windows 3.1. Describe how you handle the situation.
30. What key do you press to bring up the Windows 9x Startup Menu during the boot process?

PROJECTS

Interacting with the User

Rob, a PC service technician, has been called on-site to repair a PC. He has not spoken directly with the user, but he knows the floor of the building where the user, Lisa, works and can look for her name on her cubicle. The following is a description of his actions. Create a table with two columns. List in one column the mistakes he made and in the next column the correct action he should have taken.

Rob's company promised that a service technician would come sometime during the next business day after the call was received. Rob was given the name and address of the user and the problem, which was stated as "PC will not boot." Rob arrived the following day at about 10 a.m. He found Lisa's cubicle, but she was not present. Since Lisa was not present, Rob decided not to disturb the papers all over her desk, so he laid his notebooks and tools on top of her work.

Rob tried to boot the PC and it gave errors indicating a corrupted FAT on the hard drive. He successfully booted from a disk and was able to access a C prompt. A DIR command returned a mostly unreadable list of files and subdirectories in the root directory. Next Rob used Norton Utilities to try to recover the files and directories but was unable to do so. He began to suspect that a virus had caused the problem, so he ran a virus scan program that did not find the suspected virus.

He made a call to his technical support to ask for suggestions. Technical support suggested that he try partitioning and formatting the hard drive to remove any possible viruses and recover the hard drive. Rob partitioned and formatted the hard drive and was on the phone with technical support and in the process of reloading Windows 98 from the company's file server when Lisa arrived.

Lisa took one look at her PC and gasped. She caught her breath and asked where her data was. Rob replied, "A virus destroyed your hard drive. I had to reformat."

Lisa tried to explain the importance of the destroyed data. Rob replied, "Guess you'll learn to make backups now." Lisa left to find her manager.

Using Some Nuts & Bolts Diagnostic Tests

Follow these directions to perform a series of diagnostic tests on your computer, using Nuts & Bolts.

1. In Windows 9x, click Start, Programs, Nuts & Bolts, and select Discover Pro.
2. From the Discover Pro main screen, select the Diagnostics tab.
3. Although you can perform the five diagnostic tests listed from this screen, to have more control over the tests, click the Advanced button on the bottom of the screen.
4. Select the hard drive test by clicking the HD Diag button on the left side of the screen. Select the hard drive from the list of drives on the right side. Click Start to perform the test. Print the results of the test by clicking Print.
5. Perform and print the results of each of the remaining four diagnostic tests.

Using the Windows Control Panel

1. Using the Windows Control Panel, set your monitor to Low power, Standby, or Doze Mode.
2. Using the Windows Control Panel, record the current video driver and video resolution settings. Then change the video driver to Standard VGA with a 640 3 480 resolution. Reboot the computer and change the video resolution back to the original settings.
3. Using the Windows Control Panel, add a new printer (choose any from the printer list). When done, remove the printer driver, then check to confirm that the correct printer is set as the default.
4. Log on to the Internet and download one of the diagnostic utilities mentioned earlier in the chapter. Use it to test your home or lab computer.

Take a Computer Apart and Put It Back Together

Follow these general guidelines to take a computer apart and put it back together:

1. Put the computer on a table with plenty of room. Have a plastic bag or cup available to keep screws from being lost. When reassembling the PC, insert the same screws in the same holes. (This is especially important with the hard drive. Screws that are too long can puncture the hard drive housing.) You'll need a Phillips-head screwdriver and a flat-head screwdriver, paper, and pencil.
2. Leave the computer plugged in so that it's grounded or follow the directions of the instructor to ground the computer as you work. If your computer uses CMOS for setup, print out all settings or save them to a floppy disk. Make a bootable disk if you don't already have one. Turn the computer off.
3. If necessary, remove the monitor from the top of the case. Unplug and remove the mouse and keyboard.
4. Remove the case cover. For some desktop computers, the case slides to the front; others lift off. For tower cases, from the back, lift the cover up and then slide it to the back before removing it (see Figure 8-11). After you set the top aside, ground yourself by touching the computer case to discharge any static electricity on your body.

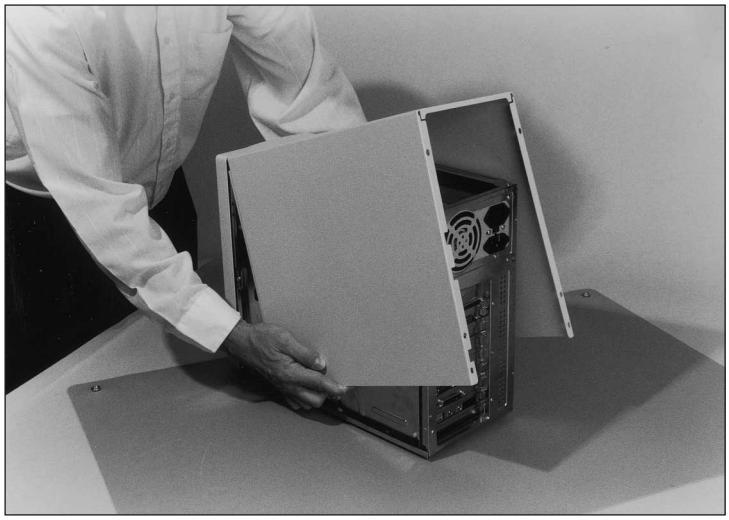

Figure 8-11 To remove the cover of a tower case, lift up the backside and then slide the cover toward the rear

5. Draw a diagram of all cable connections, DIP switch settings, and jumper settings. You might need the cable connection diagram to help you reassemble. You will not change any DIP switch settings or jumper settings, but accidents do happen. Be prepared. If you like, use a felt-tip marker to make a mark across components to indicate a cable connection, board placement, system-board orientation, speaker connection, brackets, and so on, so that you can simply line up the marks when you reassemble.
6. Before removing the cables, note that each cable has a color or stripe down one side. This edge color marks this side of the cable as pin 1. Look on the board or drive that the cable is attached to. You should see that pin 1 or pin 2 is clearly marked. Verify that the edge color is aligned with pin 1. Look at the cable used to connect drive A to the floppy drive controller card. There is a twist in the cable. This twist reverses these leads in the cable, causing the addresses for this cable to be different from the addresses for the cable that doesn't have the twist. The connector with the twist is attached to drive A (see Figure 8-12). Remove the cables to the floppy drives and the hard drives. Remove the power supply cords from the drives.

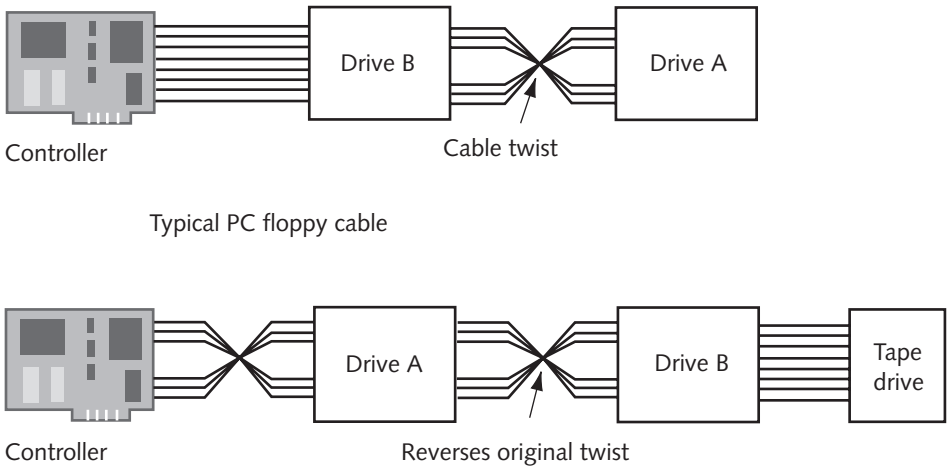

Figure 8-12 Twist in cable indentifies drive A

7. Remove the expansion cards. There is usually a single screw holding each card to the back of the case. Remove the screws first, and place them in your cup or bag. When removing a card, don't rock the card from side to side, because you can spread the card's slot, making connections more difficult. Don't rock the card from back to front. Don't put your fingers on the edge connectors or touch a chip. Don't stack the cards on top of one another. Lift the card straight up from the slot.
8. Remove the floppy drives next. Some drives have one or two screws on each side of the drive attaching the drive to the drive bay. After you remove the screws, the drive usually slides to the front and out of the case. Sometimes there is a catch underneath the drive that you must lift up as you slide the drive forward. Be careful not to remove screws that hold the circuit card on top of the drive to the drive housing. The whole unit should stay intact.
9. Remove the hard drive next. Look for the screws that hold the drive to the bay. Be careful to remove only these screws, not the screws that hold the drive together. Handle the drive with care.
10. You might need to remove the power supply before exposing the system board. Unplug the power supply lines to the system board. An ATX power supply only has a single power line, but for an AT power supply, carefully note which line is labeled P8 and which is labeled P9. You will want to be certain that you don't switch these two lines when reconnecting them, since this would cause the wrong voltage to flow in the circuits on the system board and can destroy the board. Fortunately, most connections today only allow you to place the lines in the correct order, which is always black leads on P8 next to black leads on P9. Remember, "black to black." Look for screws that attach the power supply to the computer case, as shown in Figure 8-13. Be careful not to remove any screws that hold the power supply housing together. You do not want to take the housing apart. After you have removed the screws, the power supply still might not be free. Sometimes it is attached to the case on the underside by

recessed slots. Turn the case over and look on the bottom for these slots. If they are present, determine in which direction you need to slide the power supply to free it from the case.

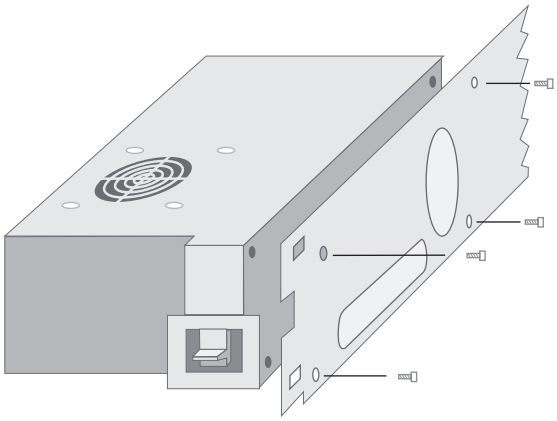

Figure 8-13 Removing the power supply mounting screws

11. The system board is now the last thing to be removed. It probably has spacers keeping it from resting directly on the bottom of the computer case. Carefully pop off these spacers and/or remove the three or four screws that hold the board to the case.
12. Now that the computer is fully disassembled, reassemble it in reverse order: first the system board, then the power supply, the hard drive, the floppy drives, the expansion cards, and the cables. Refer to your diagrams and marks on the cables as needed.
13. Before replacing the computer case, plug in the monitor and keyboard and have your instructor inspect your work. Do one last visual inspection before turning on the power. Then turn on the power and make sure everything works. If the computer doesn't work the first time, don't panic. You probably have not connected something snugly enough. Turn off the power and double-check all cards, cables, and power cords. Refer to your drawings and make sure that all cables are attached correctly. If the machine still doesn't work, it's possible you loosened a chip on a board as you were working. Use a screwdriver or your fingers and firmly but carefully push down all four corners of every socketed chip on the system board. As you work, be certain to turn off the power before touching the inside of the machine. Once the machine is working, replace the cover and you're done.

Practice Makes Perfect

Repeat the previous project using a different model of computer. You should feel comfortable disassembling and reassembling a computer before you leave this exercise.

Using the Help Feature in Windows 9x

Research the Help feature in Windows 9x. From the **Start** button, choose **Help**. The window shown in Figure 8-14 appears, showing the Index tab selected. Type the first few letters of the word you want to search for, and then click the index entry you want. Click **Display**.

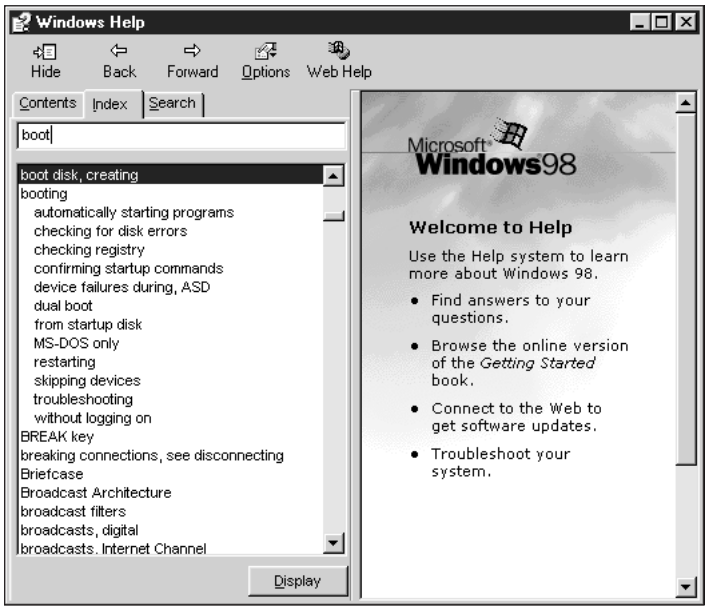

Figure 8-14 The Windows 98 Help Index window

For Windows 95, Figure 8-15 displays the Find tab. Type the word to find, click on one of the topics listed, and select **Display**. Using the Windows 95 Help tool, list the steps for making a backup of the \Windows\System folder to disk. List the steps to restore the \Windows\System folder from disk.

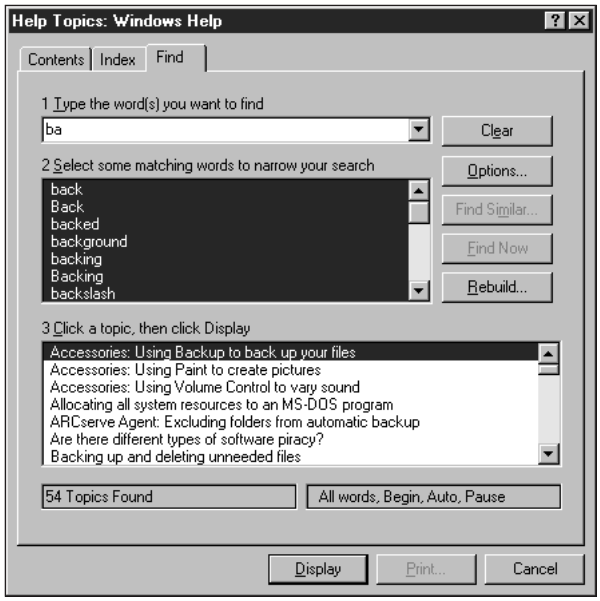

Figure 8-15 The Windows 95 Help Find sheet

Using the Help Feature in Windows 98

Windows 98 offers a troubleshooter to help with problem solving, which is displayed in Figure 8-16. Research the feature in Windows 98. From the **Start** button, choose **Help**. Under the **Index** tab, enter the word **Monitor** or **Troubleshooting**. Print the list of problems that the Windows 98 Display Troubleshooter addresses.

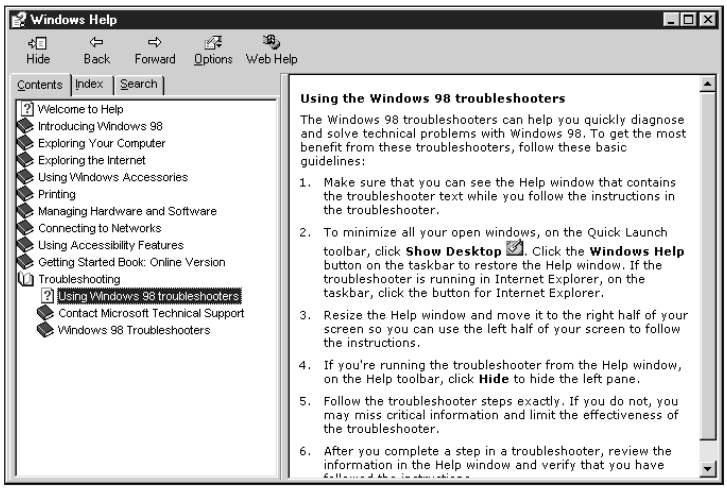

Figure 8-16 The Windows 98 Troubleshooter is an interactive tool to help solve computer problems

Troubleshooting a Modem Problem

Now let's apply what you've learned so far to a new situation. An external modem is connected to a PC. When you attempt to use the modem, you get the error message "Modem not found." There is a working PC and external modem nearby. List the steps to determine if the problem is with the PC, the modem, or the modem cable. Why can you assume that the problem is not with the phone line?

Troubleshooting a Boot Problem

Edit the CONFIG.SYS file on your PC. If you are using an installation of Windows 9x that does not use a CONFIG.SYS file, then create one. Enter a command line in the file that you know will cause an error. Boot the PC. Press F8 during the boot and walk through the boot process to demonstrate how this procedure can be used to diagnose a problem with startup files.

Correct the command line in CONFIG.SYS and boot again, walking through each command in the boot process.

Developing Help-Desk Skills

Work with a partner who will play the role of the user. Sit with your back to the user, who is in front of the PC. Troubleshoot the problem and talk the user through to a solution. Abide by these rules:

1. A third person has previously created an error on the PC so that the PC does not boot successfully. Neither you nor your partner knows what the third person did.
2. The user pretends not to have technical insight but to be good at following directions and willing to answer any nontechnical questions.
3. Don't turn around to look at the screen.
4. Practice professional mannerisms and speech.
5. As you work, keep a log of the "phone call to the help desk," recording in the log the major steps toward diagnosing and correcting the problem.
6. When the problem is resolved, have the third person create a different problem that causes the PC not to boot correctly, and exchange roles with your partner.

Adjusting a Monitor

Using the documentation that accompanies a monitor, learn to adjust the monitor using the buttons on the monitor. In a class situation, demonstrate your skills to the class and answer any questions others may have.

Save CMOS Setup Using Freeware

Research the Internet for freeware to save CMOS setup data to floppy disk. Print the web page of the product. Download the program and use it to save the setup data to disk. When you run the software, print the main menu of the software. Try these web sites when looking for software: *www.zdnet.com, www.geocities.com.*, and *www.download.com*.